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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CENTER RELATED RESEARCH GRANT

NGL-19-001-097



FINAL REPORT

September, 1971 to August 31, 1974

Submitted August, 1974

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Report Prepared By

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INTRODUCTION

A research proposal was submitted to NASA in the spring of 1971 with the primary objectives of meeting the requirements and needs of NASA and to develop faculty research capabilities at Louisiana State University, which would complement the activities of a NASA "Center". In this instance the center under consideration was the NASA Mississippi Test Facility.

At the time of the proposal submittal we recognized the inevitable cancellation of the NASA Sustaining University Program which was a viable element in the overall research program at LSU. It was proposed to replace the old SUP projects with a program which was related to the development of the Mississippi Test Facility as a research center, and at the same time support those SUP projects which were making a contribution toward center development.

In May, 1971, the proposal submitted by LSU was approved at a level of support of \$50,000, step funded over a three year period, on the condition that an effective program of research at this level could be provided by LSU. The funding levels were: \$5,000 for 1971-72; \$20,000 for 1972-73; and \$25,000 for 1973-73. The program would be terminated at the end of the third year, at which time LSU would, or should, have phased-in a new research effort.

The University administered the grant according to NASA policy and supported only those projects which contributed the most to the advancement of scientific knowledge. Several interdisciplinary research efforts were proposed in the initial stages of the program, however, due

to developments within the NASA/MTF and LSU, a letter was submitted to the office of University Affairs requesting a change in the major objectives of the grant (See Appendix A). That is, we proposed to support ongoing SUP projects and to help support the new LSU remote sensing program which was related to the MTF Earth Resources Laboratory mission.

The following sections summarize the efforts of this program. In the appendices are included such information as number and name of faculty, professional staff and students, a list of publications, and degrees awarded. This has been a most beneficial program. We felt that the University, and especially this College of Engineering, is better equipped for graduate research and academic endeavors due to the benefits derived from this grant.

GENERAL DISCUSSION

1. Administration Policy

Since this research grant was so closely related to the LSU Sustaining University Program and other proposed work it was placed under the general direction of Dr. Charles A. Whitehurst who was a member of the LSU/SUP committee. This committee was formed to encourage and coordinate research, and to channel funds necessary for supporting research in a space oriented effort. It was only logical that they assume responsibility for this new grant.

2. Research Programs Supported

A. 1971-1972

In this reporting period research funds were used primarily in support of the Principal Investigator (Dr. Whitehurst) and one staff assistant. The work accomplished in this period,

which was directly related to this grant, consisted of the following projects.

A program of instrumentation development, and specifically the development of a spectral analyzer, was initiated for the purpose of investigating and identifying general classes of environmental pollutants. The project was completed and a report delivered to NASA/MSFC.

The other tasks supported in this year dealt with a basic investigation of plant physiology. A report entitled "A Model of the Physiological Systems of Vegetation" was published by the Division of Engineering Research as Bulletin No. 105.

An additional report was published in this area in 1972 and forwarded to NASA/OUA. The title was "Selected Bibliography of the Modeling and Control of Plant Processes".

In addition, a proposal was written and accepted by the Marshall Spaceflight Center, Huntsville, Alabama, which dealt with urban transportation problems in New Orleans.

B. 1972-1973

Two projects were supported during this period, (1) "Remote Sensing Technology Applied to Transportation Planning" and (2) "A Study of Salt Water Encroachment in Bayou Lafourche." A brief description of these efforts follows.

1. Project I- Transportation

Origin-destination surveys are the principal source of data input for analyzing the transportation systems within urban areas. Because of their high costs, origin-destination surveys are typically done between long periods of time making the updating of travel data and the checking of the continuing validity of travel models difficult.

The susceptibility of origin-destination surveys to virtually uncontrollable sources of error and bias, in addition to high costs, has lead researchers to look for new methods of obtaining travel information. The examination of a system of remote sensing which may be applicable, among other things, to data collection for transportation planning was the primary objective of this project. By utilizing the airborne sensing technology developed by NASA, an urban area may be photographed continually during an entire day providing data -- travel data, land use data, traffic characteristics data, facility inventory data, etc., -- for input to transportation system analysis that is homogeneous with respect to time frame. As a pilot study to determine the feasibility of this method of data collection, an area of approximately one (1) square mile was selected in New Orleans, Louisiana, to serve as an analysis district.

This project was completed as far as the LSU effort is concerned and a report delivered to NASA/MSFC.

2. Project II- Salt Water Encroachment

In our original proposal to NASA we proposed to initiate the development of a closed ecological system wherein the effect of changes in environmental parameters on the system could be investigated. We proposed to call the system an "Ecoloquarium" and to construct it on the Mississippi Test Facility site. This proved to be much too ambitious for the resources available to the research teams and it was determined that more basic work should be accomplished. It was at this time that the projects on vegetation

analysis were initiated. They were completed and forwarded to NASA. These efforts were followed by a study of salt water intrusion into Bayou Lafourche. A complete inventory of natural resources in this region was underway as an integral part of our Earth Resources program. A study of salt water intrusion, sediment transport, and the general condition of water quality in Bayou Lafourche was of major significance during this reporting period.

In order to model the transport of particles in such a flowing stream, the equations characterizing the drag characteristics of the suspended particles, as well as the equations defining the flow field, must be solved, yielding trajectories of the suspended particles. Using these relationships, the paths of sample particles in a representative section of the stream were defined, and the transport and deposition of suspended material modeled.

The transport mechanism at the intersection of Bayou Lafourche and the Intercoastal Canal was our first study case. Distortions in geometry and other physical characteristics made this case unprofitable. We then proceeded to model only the intrusion of salt water. Ground truth data was correlated with data obtained from NASA/ERL remote sensing flights, to the maximum extent possible. Turbidity and color information from these flights offered the most information.

The final results of the modeling study, which was completed this year by the Coastal Studies Institute, are submitted with this final report.

C. 1973-1974

A complete study of Plant Types, Seasonality, and Quantity of Production in the Area of Lake Pelto, near Bayou Lafourche, Louisiana was accomplished during this study period.

The nature of most coastal wetlands is poorly known even where mapped. In order to improve our ability to map the wetlands, additional research into spectral signatures is needed; and the fact that the spectral signatures of the vegetation changes seasonally, makes this a difficult and tedious problem.

The inception of these changes, and the rate of change needs to be studied so that the relative and seasonal contributions of organic material from the wetlands to the estuaries can be determined.

This project was accomplished with the assistance of personnel from Nicholls State University and a report delivered to NASA/OUA. Partial support for this project was provided from NASA Grant 19-001-105.

A Research Monograph has been published concerning this effort and copies are included in this report.

There were no other specific tasks supported under this grant during this period. Substantial assistance to the projects funded under the Earth Resources Program was provided and these reports have been or will be submitted to NASA this year.

Summary

This entire program has been most beneficial to the Louisiana State University graduate program, especially in the College of Engineering. It has been instrumental in broadening the interests of the persons who

participated and has been a key factor in developing the interdisciplinary interests of the University. We feel that grants of this nature should continue. The direct benefit to a particular NASA program may not be immediately realized; however, the benefits accrued to NASA, LSU, and the national interests over a period of time is more lasting, and in the long-term, more valuable.

We cannot measure some of the benefits derived from this program; we can determine a few of them. For example, the figures cited below represent a very definite and measurable benefit to LSU:

Number of faculty participants	8
Number of faculty receiving financial support	5
Number of graduate students	4
Number of undergraduate students	4
Number of professional associates	2
Number of Ph.D. candidates supported	1
Number of M.S. candidates supported	3
Number of reports published	4
Number of disciplines participating	6

It is clearly indicated by these figures that much has been accomplished with this grant. The multidisciplinary and interdisciplinary aspects of the total program are clearly shown in the number of faculty who participated and their disciplines. Most faculty members are aware of other disciplines and we are encouraged by willingness of the various departments to work together. This grant has, in a large measure, made this possible.

If you need further information regarding the management, or any other aspects of this program, please advise the office of the director of the Division of Engineering Research.

APPENDIX A

LETTERS RELATED TO THE
CHANGE IN OBJECTIVES AND EMPHASIS OF
THIS PROGRAM

October 18, 1971

Mr. Edward Redding
Office of University Affairs, Code Y
National Aeronautics & Space Administration
Washington, D. C. 20546

Dear Mr. Redding:

Enclosed are copies of the Progress Reports and Final Reports on projects funded by NASA Grant #19-001-024 in the year September 1, 1970 through August 31, 1971.

Report Number 1 is a final report from the Department of Otorhinolaryngology entitled "A Study of the Relationships Between the Mechanical Response of the Tympanic Membrane and the Electrophysiological Indicators of Hearing in the Bullfrog." This work was originally supported by the grant and included the use of laboratory facilities and support personnel at the Mississippi Test Facility. The principal investigator, Dr. Deborah A. Majeau-Chargois, is continuing this work under the auspices of the Louisiana State University Medical Center.

The second report is a progress report on the Bioengineering Research Facility at the Mississippi Test Facility. This work has been supported by the NASA grant since 1969. Its relevance to the space program has been recognized through its applicability to waste management problems in the manned space stations of the near future. Dr. Dunlap, principal investigator, will diversify his efforts in the coming year to include research in the development of environmental instrumentation.

The third report is a Progress Report of "The Design and Construction of a Hohlraum Spectral Analyzer." This program of instrumentation development, and specifically the development of the spectral analyzer was initiated for the purpose of investigating and identifying general classes of environmental pollutants. The design and construction phase of this program is near completion. The instrumentation development will be continued by performing the following tasks:

1. Obtain spectral characteristics for gas mixtures with known quantities of pollutants. The pollutants to be tested are carbon monoxide, carbon dioxide, hydrogen sulfide, nitrogen dioxide, and sulfur dioxide. These gases are on order and should be delivered by the 15th of November.
2. To produce spectral traces of unknown samples. These unknown traces will be identified by comparison with traces obtained in Task 1.
3. To develop data handling equipment and software programs for data reduction from real problems.

Mr. Edward Redding
October 18, 1971
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Finally, in our last proposal to the NASA Office of University Affairs, we proposed to initiate the development of a closed ecological system wherein the effect of changes and environmental parameters on the system could be investigated. We proposed to call the system an "Ecoloquarium". This proves to be much too ambitious for the sustaining university program and was considerably beyond the resources of the Mississippi Test Facility. We have determined that more basic work should be accomplished before the construction of a complete laboratory is undertaken. Therefore, we have funded an effort in Electrical Engineering and a preliminary report is submitted herein. The report, entitled "A Model of the Physiological Systems of Vegetation," has been published by the Division of Engineering Research as Bulletin No. 105. We have attempted to explain the working mechanisms of a plant system in order to determine the possibilities for controlling the plant processes.

Work will be continued in 1971-72 in the following areas: (1) bioprocessing, (2) instrumentation development, and (3) continuing in the area of plant modeling. In addition, we are completing a report on the effects of random noise on structures. This work was initiated in 1969 and all data collected at the Mississippi Test Facility. Due to circumstances beyond our control, the work was interrupted for over a year. The graduate student, Dennis Bilyeu, is completing research under the principal investigator, Dr. Gerald Whitehouse.

Additional copies of these reports are being sent to you under separate cover.

Sincerely,

C. A. Whitehurst

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July 11, 1972

Mr. Edward Redding, Code Y
Office of University Affairs
National Aeronautics and Space
Administration Headquarters
Washington, D.C. 20546

Re: NASA Grants NGL 19-001-024 and NGL 19-001-097

Dear Mr. Redding:

Enclosed are the description reports of the projects being supported under the subject grants. In accordance with your request, I have included a brief description of projects supported during 1971-72 time period.

We are forwarding to you under separate cover several copies of a report entitled "Selected Bibliography of the Modeling and Control of Plant Processes," which is the second report dealing with the modeling of vegetation. We hope at a later time to continue these studies by applying the results of our models and the results obtained from remote sensing studies to practical applications in land use definitions. Please note that we are discontinuing the studies in single cell protein production, and that all efforts in the future will be directed toward our remote sensing studies in the Bayou LaFourche region of South Louisiana. One exception to this is the very small study, related to urban transportation problems, being conducted in the New Orleans area.

Final reports will be forwarded to you as they are completed and published. If you need further information, please contact the undersigned.

Sincerely,

C. A. Whitehurst
Grant Coordinator

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APPENDIX B

PERSONNEL SUPPORTED UNDER THE NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION CENTER RELATED RESEARCH PROGRAM

GRANT NUMBER 19-001-097

September 1, 1971 to August 31, 1974

Tables on the following pages represent the faculty, professional staff, graduate and undergraduate students, who participated in projects supported by this grant. Table I names faculty members; Table II, professional staff; and Table III, students. The disciplines involved are listed with each name. The asterisk denotes those personnel not receiving NASA funds from this grant, but who did participate in the research.

TABLE I
FACULTY PARTICIPANTS
NGR 19-001-097

<u>NAME</u>	<u>RANK</u>	<u>DEPARTMENT</u>
Dantin, Elvin J.	Professor	Water Resources, Civ. Eng.
Julich, Paul M.*	Assoc. Prof.	Electrical Engineering
Kinney, Ralph A.	Assoc. Prof.	Electrical Engineering
McPhate, A.J.	Assoc. Prof.	Mechanical Engineering
Maples, Dupree*	Assoc. Prof.	Mechanical Engineering
Modlin, David G., Jr.*	Asst. Prof	Civil Engineering
Ragan, James	Assoc. Prof. (Nicholls)	Marine Biology
Whitehurst, Charles A.	Professor	Engineering Research

TABLE II
PROFESSIONAL STAFF PARTICIPANTS
NGR 19-001-097

<u>NAME</u>	<u>TITLE</u>	<u>DEPARTMENT</u>
Durbin, Warren T., Jr.	Research Assoc.	Engineering Research
Featherston, Billie S.	Secretary	Engineering Research

TABLE III
STUDENT PARTICIPANTS
NGL 19-001-097

GRADUATE STUDENTS

Doiron, Linda
Milliet, Michael P.
Monte, Judith A.
Pecquet, Richard A.

STUDENT EMPLOYEES

Cole, Cheryl
Dantin, David
Jennings, Betty
Leblanc, Mark

APPENDIX C

PAPERS AND REPORTS PUBLISHED
PRESENTATIONS AND UNPUBLISHED PAPERS AND REPORTS
GRANT NUMBER 19-001-097

September 1, 1971 to August 31, 1974

PAPERS AND REPORTS
PUBLISHED

- Green, J.H., Ragan, J.G., and Whitehurst, C.A., "Remote Sensing as an Aid for Marsh Management," Research Monograph RM-2, Division of Engineering Research, L.S.U., Baton Rouge, La., May, 1974.
- Julich, P.M., and Viswanathan, M.M., "Selected Bibliography on the Modeling and Control of Plant Processes," Report to NASA, Division of Engineering Research, L.S.U., Baton Rouge, La., 1972.
- Maples, D., and Hagewood, J.F., "Design and Construction of a Remote Sensing Apparatus," NASA Final Report, Division of Engineering Research, L.S.U., Baton Rouge, La., 1972.
- Waldrop, W.R., Farmer, R.C., and Bryant, P.A., "Saltwater Intrusion Into a Flowing Stream," TR 161, Coastal Studies Institute, L.S.U., Baton Rouge, La., May, 1974.